

**The
National
Aeronautics
and
Space
Administration**



National Space Grant College and Fellowship Program

**Exploration Systems Mission Directorate
Higher Education: Development of an
Engineering Senior Design Course**

2009 Announcement

November 13, 2009

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Exploration Systems Mission Directorate
Higher Education- 2009 Announcement

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**NASA Exploration Systems Mission Directorate
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Higher Education: Development of an Engineering Senior Design
Course 2009 Announcement**

I. Introduction

NASA's Exploration Systems Mission Directorate (ESMD) is soliciting proposals for a higher education opportunity to develop an ESMD Engineering Senior Design Course. Senior design projects are intended to stimulate undergraduate research on current NASA activities and to bring out innovative and novel ideas that can be used to complement those currently under development at respective NASA Centers. Additionally, such academic involvement would improve the prospects for graduating seniors to pursue graduate studies and to seek careers in the Space industry. The senior design course to be developed for this solicitation must be in one of the four ESMD-related areas: propulsion, lunar and planetary surface systems, spacecraft or ground operations (see Background Section for more information).

In 2007, ESMD announced the first solicitation for the development of two senior design courses. The courses were successfully pilot-tested at Auburn University and Michigan Technological University during the 2008-2009 academic year. These courses are located at <http://education.ksc.nasa.gov/ESMDspacegrant/CoursesIndex.htm>. Utah State University is currently pilot-testing the third ESMD Senior Design Course.

We invite university faculty who teach engineering senior design courses to submit a proposal to develop a two-semester senior design course in one of the four identified ESMD areas. Each proposal must include a signed commitment from the NASA Technical Expert to ensure their commitment to the project. The project for the senior design course must be selected from the approved list found at http://education.ksc.nasa.gov/ESMDspacegrant/Sr_Design.htm. The NASA Technical Expert is not listed on this site. To obtain a specific name of a NASA Technical Expert contact Susan Sawyer at 321-867-5482, Susan.G.Sawyer@nasa.gov.

II. Pertinent Dates

Date of Announcement: November 13, 2009

Proposal Due Date: December 21, 2009, 5 p.m. Pacific Time

III. Eligibility Requirements

Proposals will be accepted from U.S. citizens and currently employed faculty who teach an engineering senior design course at a university affiliated with The National Space Grant College and Fellowship Program.

IV. Background and Purpose

The Exploration Systems Mission Directorate (ESMD) is dedicated to creating a constellation of new capabilities, supporting technologies and foundational research that enables sustained and affordable human and robotic exploration.

NASA delivers a comprehensive Agency education portfolio, implemented by the Office of Education, the mission directorates, and the NASA field centers. Through the portfolio, NASA contributes to our Nation's efforts in achieving excellence in science, technology, engineering and math (STEM) education. Three outcomes serve to align all Agency education activities. This announcement maps to Outcome 1: Contributing to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals.

The purpose of the ESMD Space Grant Project is to train and develop the highly skilled scientific, engineering, and technical workforce of the future needed to implement the U.S. Space Exploration Policy.

The following are areas critical to the future of space exploration. All senior design projects are linked to one of the four areas:

Spacecraft- Guidance, navigation and control; thermal; electrical; structures; software; avionics; displays; high speed re-entry; modeling; power systems; interoperability/commonality; advanced spacecraft materials; crew/vehicle health monitoring; life support.

Propulsion- Propulsion methods that will utilize materials found on the moon or Mars, "green" propellants, on-orbit propellant storage, motors, testing, fuels, manufacturing, soft landing, throttle-able propellants, high performance, and descent.

Lunar and Planetary Surface Systems- Precision landing hardware, software, in-situ resource utilization (ISRU), navigation systems, extended surface operations, robotics, (specifically environmental scouting prior to human arrival, outpost maintenance with and without humans present, and assist astronaut with geologic exploration) environmental analysis, radiation protection, spacesuits, life support, power systems.

Ground Operations- Pre-launch, launch, mission operations, command and control software systems, communications, landing and recovery.

V. Development of an Exploration Systems Senior Design Course

ESMD is requesting proposals for the development of an ESMD approved senior engineering design course that adheres with the Accreditation Board for Engineering and Technology (ABET) quality standards. The course will span an academic year (approximately 32 weeks) and be developed in conjunction with a current NASA ESMD project. The end product will be a “packaged” senior design course that can easily be incorporated into universities across the nation.

University engineering professors who are interested should propose an ESMD senior design course that they would like to develop. They must choose from the current list of senior design projects (http://education.ksc.nasa.gov/ESMDspacegrant/Sr_Design.htm) and contact the NASA Technical Expert to ensure their commitment to the project. To obtain a specific name and contact information of a NASA Technical Expert contact Susan Sawyer at 321-867-5482, Susan.G.Sawyer@nasa.gov.

The selected professor will develop the course during the spring 2010 semester and pilot test the course during the 2010-2011 academic year. All applicants must provide proof that the course has been approved to be taught at their institution in 2010-2011 academic year. The developed course will be implemented at other universities during the 2011-2012 academic year. The selected professor must be available for technical assistance to the implementing universities during the 2011-2012 academic year.

The selected professor will present the course at the Kennedy Space Center to a review panel consisting of the NASA Project Manager, NASA Systems Engineers, and Space Grant Consortia Senior Design Faculty. The selected professor will present the course at the National Space Grant Consortia meeting in Portland, Maine in the fall of 2010. The selected professor will conduct a one day faculty workshop in the summer of 2011 for the implementing university faculty.

Applicants are required to apply a systems engineering approach for the senior design course. See the NASA Systems Engineering Handbook at [Site Documents/NASA SP-2007-6105.pdf](#)

Responsibilities of the selected professor

The professor will create and compile all materials for the course. The professor will produce a “packaged” senior design course. University faculty will receive the course at a later date to easily integrate into their institutions. All initial course materials must be completed and submitted electronically to NASA by June 1, 2010. All equipment purchased and course materials created will belong to NASA. The professor must enter a report into the NASA Education database for metrics. The professor will produce all deliverables defined below.

Deliverables:

Bimonthly Reporting

- Written status of course development and testing
- Teleconference status of course development and testing

Course Materials

- Handbook detailing the course and background information
- PowerPoint lectures for the senior design course for an academic year
- Related research articles (.pdf)
- List of related websites
- List of vendors and cost of materials needed for others to use to implement the course
- Proposal for University Regulatory Committee (a clear description of the course along with milestones, timelines, budget)

Revised Course Materials

- Any changes required to the course materials need to be submitted after the pilot test year and again after the implementation year.

Webpage

- All materials required by students during the pilot year need to be provided via web at the professor's university.
* Note: Final materials required by implementing universities will be provided via NASA website.

Final Report

- Purpose of ESMD senior design course development
- Defining senior design projects and their significance to engineering programs
- Overview of ESMD senior design course developed
- Systems engineering process, documentation, reviews and activities
- Assessment results
- Definition of International Traffic in Arms Regulations (ITAR) & Export Administration Regulations (EAR) regulations and their applicability to the chosen topic
- Lessons learned
- Suggestions for changes and improvements for future implementation

Travel

- Present developed course at Kennedy Space Center to a review panel in the summer of 2010.
- Present developed course at the National Space Grant Meeting in the fall of 2010 in Portland, Maine.
- Meet with the NASA Technical Expert as required.
- Conduct a one day faculty workshop in the summer of 2011 for the implementing university faculty.

Schedule of Deliverables:

Initial Course Materials:	June 1, 2010
Presentation to Review Panel:	July 2010
Pilot Test:	2010/2011 Academic Year
Revised Course Materials:	June 1, 2011
Presentation to National Space Grant Consortia Mtg:	October 14-16, 2010
Workshop:	Summer 2011
Tech Assistance to Faculty at Implementing Universities:	2011/2012 Academic Year
Final Course Materials:	June 1, 2012
Final Report:	July 1, 2012

General Requirements for the Senior Design Course

1. The project must present a significant ESMD design challenge to the students in the class.
2. The project must incorporate knowledge from three or more engineering disciplines. Systems engineering process is required. See the NASA Systems Engineering Handbook at [Site Documents/NASA SP-2007-6105.pdf](http://www.nasa.gov/pdf/SP-2007-6105.pdf)
3. The design and fabrication work on the project must be of a level that is worthy of 6 hours of coursework credit. The project should take approximately 250 hours for students to complete.
4. The project must require creativity and deductive reasoning be applied in the solution of the design task and supporting analysis. There should also be a significant involvement of appropriate computer-aided tools in its design solution.
5. The overall design framework must incorporate realistic constraints covering economic, environmental, sustainability, manufacturability, ethical, human health and safety, social, and societal constraints.

VI. Proposal Format and Content

Proposals should be single-spaced on standard 8 ½ x11 paper, no smaller than 12 point font and with one inch margins throughout. All proposals must be prepared in the following format:

1. **Title Page** (not included in the page count) - Title of senior design course, name and contact information of proposing faculty (address, university affiliation, email address, phone number), name of NASA Technical Expert associated with senior design course, and the local Space Grant Consortium in which faculty is affiliated.

Data Universal Numbering System (DUNS), Online Representations and Certifications Application (ORCA), and Central Contractor Registration (CCR) - All applicants are required to obtain a DUNS number, register in ORCA, and register with CCR to submit a proposal for this solicitation. The DUNS number and Cage Code number **must** be on the title page.

INSTRUCTIONS ON OBTAINING DUNS, ORCA & CCR: To register in ORCA, individual/vendors go to <https://orca.bpn.gov/>. To register in CCR, individual/vendors go to <http://www.ccr.gov/> and select “Start New Registration”. Once selected, if the individual/vendor does not have a DUNS number, select “Request DUNS Number” on the left hand side. Please do not contact NASA with questions concerning registering in CCR, ORCA or DUNS. If your questions/concerns are not addressed on the webpage, call CCR Assistance Center at 866-606-8220.

2. **Body of Proposal (6 pages maximum)**
 - **Proposal Synopsis** – description of the chosen ESMD senior design project, design challenge to the students, and complexity.
 - **Significance-** description of the need and relevancy of the proposed senior design project for NASA, and how this course will benefit the university.
 - **Content** – description of the course outline and structure and the faculty workshop outline. Applicants should also describe the involvement of appropriate computer-aided tools in its design solution. Applicants should also describe how the NASA Systems Engineering process will be applied.
 - **Mechanisms for integration-** description of how the course will be integrated and pilot tested at the affiliated university in academic year 2010-2011. Applicants should also describe the feasibility of implementing the project into other universities.
 - **Diversity** - description of effort to attract a diverse group of students, including underrepresented and underserved minorities, women, and students with disabilities. Applicants should also describe the effort to attract a diverse group of engineering disciplines.
 - **Assessment Plan** – plan for evaluation approach of senior design course, lessons learned, and potential impacts.

- **Past Performance-** demonstration of successful implementation of senior engineering design courses that met ABET quality standards. Applicants should also demonstrate experience with a systems engineering process.
 - **Other Resources (optional)** – including leveraging opportunities, unique capabilities, matching funds, and in-kind support.
3. **Schedule (not included in the page count)** - one-page overview of the proposed schedule should include the deliverables, expected dates of tangible outcomes, travel dates and final report to NASA.
 4. **Budget (not included in the page count)** - total funding requested cannot exceed \$55,000. Specific information should be given for salary, detailed expenses for supplies and materials for the course and for the project, expenses for workshop and travel (to collaborate with NASA Technical Expert, to Kennedy Space Center in summer of 2010, and to the National Space Grant Consortia meeting in Portland, ME October 14-16, 2010 (assume registration fee of \$450)).
 5. **Appendix (not included in the page count)-**
 - **Mandatory**- a signed confirmation of support from the NASA Technical Expert that is matched with the selected ESMD senior design project.
 - **Mandatory**- a signed confirmation from the university stating that the senior design course will be pilot tested in the 2010-2011 academic year.
 - Faculty may also use this section to submit their CV.

VII. Proposal Evaluation Criteria

The following criteria will be used in the evaluation process:

Mandatory Logistics

- Identify faculty institution and provide confirmation of commitment in appendix.
- Identify affiliated Space Grant Consortium.
- Identify NASA Technical Expert and provide signed statement of commitment in appendix.
- Provide DUNS and Cage Code number on Title Page.

Merit

- Demonstrate alignment with NASA ESMD objectives.
- Describe plan to integrate course into university.
- Demonstrate alignment with ABET quality standards.
- Include systems engineering process in the course.
- Include appropriate computer-aided tools in the course.
- Provide evidence of past performance of senior design courses that meet ABET quality standards.
- Provide feasibility of implementation at other universities.

Contribution to NASA Workforce Development

- **Content:** Demonstrate ability to develop a meaningful, challenging, realistic hands-on ESMD-relevant senior design project.
- **Continuity:** Demonstrate ability to create interest in NASA while connecting and preparing students for the workforce.
- **Diversity:** Demonstrate effort to attract a diverse group of student participants, including underrepresented and underserved minorities, women, and students with disabilities, along with multiple engineering disciplines.
- **Evaluation:** Provide assessment plan including appropriate quantitative metrics and qualitative outcomes.

Budget

- Provide adequate, appropriate, reasonable, and realistic budget.

VIII. Proposal Submission

Electronic copies of proposals must be received no later than: **5 p.m. Pacific Time, Monday, December 21, 2009**. Late proposals will not be considered.

The proposal will be submitted online at <https://secureworkgroups.grc.nasa.gov/esmd-sg-fp>. Membership at that site is required to submit the proposal. To join, click on “Join”, then click on Option “A”. The password is **ESMDFaculty**. The proposal may be saved as a draft before the final submission. Full details and instructions are available on that site.

A telecon will be held to answer questions on Nov 23, 1:00 PM EST.

Toll free number: 1-866-560-1157

Passcode: 7169718

FAQ's will be posted often on the following website and it is the responsibility of the applicant to check for updates.

http://education.ksc.nasa.gov/ESMDspacegrant/Course_Development.htm.

Applicants will be advised by electronic mail when selections are made. The award will be announced in Jan 2010.

Diane Ingraham will be the point of contact for questions on this solicitation:

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